Affordability of water supply in Mongolia: empirical lessons for measuring affordability

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Abstract

Affordability of water services is a pressing water policy issue for both the developed and, in particular, for the developing world. Despite its well-known theoretical shortcomings, affordability analysis of water supply has, up to now, been widely based on the ratio of a household’s water expenditure to its income, the Conventional Affordability Ratio (CAR). However, in the housing sector, alternative concepts for measuring affordability have been developed, among them being the ‘Potential Affordability Approach’ (PAA) and the ‘Residual Income Approach’ (RIA). Against this background, this paper compares these three prominent affordability measures (CAR, PAA, RIA) on the basis of an empirical case study of a peri-urban, low-income area in the second largest Mongolian city of Darkhan, using household data from a survey conducted in 2009. Thus we gain insight into both the water-related affordability situation of people in Mongolia, checking the World Bank’s finding of an absence of water affordability problems in peri-urban areas in the Mongolian capital Ulaanbaatar, as well as into the comparative functionality of different affordability measures. It is shown that affordability problems do occur but have to be distinguished depending on the economic causation. We argue that none of the regarded measures give a satisfyingly contoured notion of affordability properly distinguished from the adjacent problems of poverty and access.

\textit{Keywords:} Affordability; Mongolia; Non-pecuniary cost; Potential affordability approach; Residual income approach; Water access; Water supply

1. Introduction

Cost-recovery prices for water resources are considered to be a key prerequisite for sustainable development. At the same time, prices are expected to be affordable for social reasons. While there is a growing awareness of the social dimension of water allocation and an increasing establishment of a


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‘right to water’ (Smets, 2000; Salman & McInerney-Lankford, 2004; Riedel & Rothen, 2006; Gawel & Bretschneider, 2012a) the question of affordability is becoming more and more important for water policy. Developing countries are particularly affected with regard to the affordability of water supply, being hardly able to compensate any payment restrictions of private households by a system of social security.

A number of existing empirical studies broach the issue of water affordability in developing (and emerging) countries. However, to measure affordability, almost all of these studies rely on the ratio of water expenses to income, a measure we call the Conventional Affordability Ratio (CAR). Thus unaffordability is used to indicate households whose percentage burden of water expenses exceeds a certain target ratio. This also applies in a recent statement of the World Bank on water affordability in Mongolian peri-urban areas in the city of Ulaanbaatar (World Bank, 2010: 26). However, as noted in the literature, the CAR suffers from severe theoretical shortcomings; see Gawel & Bretschneider (2011) for an overview. Therefore, for many years now, alternative measures have been examined in theoretical affordability research, mainly in the housing sector. In any case, a sound concept of affordability with a dependable indicator is an indispensable basis for effectively pinpointing a water supply policy that takes social concerns into account. Especially in the light of the ‘right to water’ debate, further research on water affordability in developing countries is needed and is of enormous political relevance.

To date, the state of the art in theoretical affordability research has hardly penetrated the water domain. Most theoretical considerations have focused on the housing sector (Lerman & Reeder, 1987; Stone, 1990, 1993, 2006; Hancock, 1993; Chaplin & Freeman, 1999; Thalmann, 1999, 2003; Kutty, 2005; Lux, 2007). Only in recent years have these considerations also been applied – to a very modest extent – to utility markets. Miniaci et al. (2008) worked on affordability theory in the context of utility services, inter alia water services, and involved empirical figures from Italy. Kessides et al. (2009) applied these considerations to developing countries but without any empirical figures. So far, no inquiry has been presented into the domain of water provision for developing countries examining comparatively different indicators of affordability with the help of empirical data. For this purpose, this paper uses household data from an empirical case study conducted in a peri-urban, low-income area of the city of Darkhan, Mongolia. The empirical material is used to analyse the performance of different indicators of affordability theory. Comparisons of different affordability measures have already been made by Hancock (1993) for the housing domain showing that the CAR has only little value. Moreover, in a similar manner, the above-mentioned study of Miniaci et al. (2008) provides such a comparison for water utility services in Italy. García-Valiñas et al. (2010b) also compared two different affordability measures for water consumption in Southern Spain but did not connect their framework to the

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1 See Ryneveld (1995, South Africa); Tiltines (1998, Palestine); Morris & Parry-Jones (1999, Uganda); Foster et al. (2000, Panama); Anand (2001, India); Al-Ghuraiz & Enshassi (2005, Gaza-Strip); Bayrau (2005, Ethiopia); Smith & Green (2005, South Africa); Foster & Yepes (2006, Latin America); Israel (2007, Bolivia); Smets (2009, developing countries in general); Banerjee & Morella (2011, Africa); Lee (2011, Malaysia).
2 Foster & Yepes (2006) use a Potential Affordability Approach (PAA), i.e. related to a certain standard level of water consumption. Ryneveld (1995) uses a Residual Income Approach (RIA). For the differentiation, see Section 3.1.
3 Miniaci et al. (2007, 2008) derived their approach – like this study – from a discussion of housing economics. However, the majority of studies examining water affordability in developed countries do not refer to the theoretical housing affordability literature, such as Fitch & Price (2002, England and Wales); Sawkins & Dickie (2001, Scotland; 2005, Great Britain); OECD (2003, OECD countries); Reynaud (2006, France); García-Valiñas et al. (2010a, 2010b, Spain). Fankhauser & Tepic (2007) consider water affordability in transition countries.
theoretical progress achieved in housing economics. Hence, for developing countries where problems of water affordability are far more existential, such a comparative analysis is so far still lacking. This paper intends to close this gap. Moreover, we try to shed light on some institutional problems of measurement that may lead to a ‘wrong’ indication of unaffordability. Thus our contribution aims at two objectives: on one hand, for empirical value, the conditions of water supply in Mongolia will be examined; on the other hand, for theoretical value, different affordability measures will be evaluated comparatively. This analysis is made with the help of micro-level data for each household concerned.

The paper is organized as follows: in Section 2, the framework of the case study and methods of the data collection are presented; in Section 3, the affordability analysis is conducted, first as a theoretical discussion of indicators (3.1), then with a concrete normative framework for our case study (3.2), and finally with the empirical results of the case study (3.3); Section 4 then discusses the findings of the comparative affordability analysis, both within our framework (4.1) and with regard to additional aspects beyond the applied model (4.2); Section 5 concludes the paper.

2. Case study of water supply in ger areas in Darkhan (Mongolia)

This paper is based on empirical research about water supply and sanitation in Darkhan, Mongolia. The focus is on peri-urban, low-income, largely informal settlements, known as ger areas, where people live in gers (the traditional Mongolian portable felt tent) and/or in simple, detached houses. Today, in Mongolia, more than 50% of the urban population lives in ger areas. This not only holds true for the capital, Ulaanbaatar, but also for secondary cities such as Darkhan or Erdenet. In ger areas, water is generally distributed via water kiosks and residents use self-built, unsealed pit latrines with negative impacts for environmental and public health. Water from the water kiosk is used primarily for drinking and other household needs but sometimes also for business purposes, growing vegetables, livestock breeding, etc. Some residents also use water from additional water sources like rainwater harvesting, water from private wells or water from the nearby river Kharaa. This water is not monitored and bears the risk of being contaminated. Morbidity patterns in ger areas in Mongolia reveal a high rate of waterborne diseases and those related to poor environmental living conditions, such as diarrhea and hepatitis A (City of Ulaanbaatar, 2006; Basandorj & Altanzagas, 2007)4. Some residents go to other people’s homes (mainly to relatives living in apartment buildings) to have a shower or bath, and/or go to a public bathhouse (if available).

The current literature reveals that ger residents in Mongolia consume 5–10 litres per capita per day (City of Ulaanbaatar, 2006; NDIC, 2009; UNDP, 2003; 26, 2010; UNDP/UNICEF, 2004; World Bank, 2010). This raises the question of whether they are able to meet their basic drinking water needs because this is significantly below the minimum norm which is considered to be 15–25 litres per day (UNICEF & WHO, 2008) or 30–50 litres per day (UNICEF & UNDP, 2008). Why do the ger residents not consume more water from the water kiosks? Non-affordability might be an important reason. According to a study conducted in Ulaanbaatar in 2002, poor and very poor families sometimes do not collect water from the water kiosks due to income restrictions, or else they often limit the family’s consumption to 20–30 litres per day (UNICEF, 2003). In a report released by the World Bank (Mongolia – Enhancing policies and practices

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4 However, there are no data available in this regard for ger areas in Darkhan.
for ger area development in Ulaanbaatar) the authors argue the opposite: according to them, ‘affordability of water purchased at kiosks is not a significant issue for residents’ (World Bank, 2010: 26). They show that household expenditure for water represents less than 3% of ger residents’ average income, using a CAR measurement and presenting the data by income quintile. From their point of view, the only reason for the low water consumption is inconvenient transportation, indicating a non-pecuniary cost or a so-called ‘problem of access’ (Israel, 2007; Smets, 2009).

Against this background, we wanted to follow up the question of whether or not affordability of water supply is a significant issue for ger residents in Mongolia and whether or not the internationally recognized 3% rule for CAR is a reasonable approach for measuring affordability. This was done on the basis of empirical data which were collected within the framework of two German research projects

In September 2009 a household survey was conducted in a selected peri-urban ger area subdistrict in Darkhan, Mongolia’s second-largest city with a population of around 75,000 (see Sigel, 2010; Sigel et al., 2012). One of the aims was to assess household water supply and sanitation practices and households’ socio-economic characteristics. A total number of 139 residents were surveyed in their homes, corresponding to about 9% of all households in the study area. A stratified sampling procedure was used to select random samples from nine micro-districts. Care was taken to ensure that roughly the same number of households was surveyed in each micro-district and that the spatial distribution of the households within the micro-districts was as even as possible. A first version of the household questionnaire was piloted with three households, and a second version with 14 households. The household survey was carried out over a period of 10 days in September 2009 by a German researcher and three enumerators working in two groups, each working bilingually, in Mongolian and in English.

3. Affordability analysis

3.1. Measuring affordability: theoretical approaches

The common and still widely applied measure of affordability is the CAR. For the good water the burden ratio \( r \) might be defined as the share of a household’s expenditure on water (the product of water price \( p^w \) and consumed water quantity \( q^w \)) of the total income (equals total expenditure, budget \( b \)):

\[
    r = \frac{p^w q^w}{b}
\]

If the budget can be spent on either water \( w \) or a representative second good \( c \), the ratio \( r \) can be described graphically as a ray from the origin in a microeconomic household model (Figure 1).

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6 The sample size of the statistical analysis in this paper is smaller \( n = 120 \) because of errors in singular datasets.

7 Details on the organization of the survey and on the process of questionnaire definition can be found in Sigel (2010).

In such a \((q^c,q^w)\) diagram, the ray of constant burden ratio follows the equation:

\[
q^w = \frac{r}{(1-r)} \frac{p^c}{p^w} q^c
\]  

(2)

For a given price vector \(p^c/p^w\) the ray indicates all consumption combinations of water and other goods that result in a certain but constant burden share in the water budget. The affordability ray intersects the budget line (e.g. at \(S\) in Figure 1) and thus divides it into two parts. According to theorems on intersecting lines, the amount of the burden ratio \(r\), displayed graphically in Figure 1, can be described as:

\[
r = \frac{ST}{RT}
\]  

(3)

which is the lower part of the intersected budget line divided by its total length. The higher the ray’s slope, the larger the burden share \(r\).

To identify a state of (un)affordability, a target ratio \(r^*\) is set normatively. Target ratios of 3–5%, set by the World Bank, are prominent (see Table 1), and are applied by various studies of water-affordability (e.g. Bayrau, 2005; Smith & Green, 2005). Accordingly, the CAR identifies problematic situations for households whose burden ratio is higher than the target ratio. Since in the diagram a household’s consumption decision shows up as one point, the CAR would indicate an affordability problem for all households which appear above the \(r^*\) line.

When using CAR for measuring, the definition of a certain target ratio is a particular problem. Lux, for example, working in the field of housing policy, differentiated between historical, statistical, and pragmatic approaches to define the ceiling ratio (Lux, 2007: 1110). However, in microeconomic theory, this normative definition can be seen as based on two normatively defined quantities within the household model (again, see Figure 1): first, a sort of minimum quantity of the index good, ‘necessary to reach a decent standard of living’ (Kessides et al., 2009: 11), represented by \(q^w^*\) in the diagram;
and second, a minimum quantity of all consumer goods except the index good, represented by \( q^c \). This forms a point \( S \), the subsistence bundle, graphically representing the intersection point of the two minimum quantities \( q^w \) and \( q^c \) (Gawel & Bretschneider, 2010). To meet this subsistence bundle exactly, we obtain an *implicit* target ratio \( r^* \) that shows, for a given price vector, the ‘basic’ burden to be borne by the poorest. Therefore, the ray of implicit (or internal) target burden ratio \( r^* \) exactly intersects point \( S \). Pursuing the simple logic of the burden ratio, the diagram shows that, if a household chooses a consumption bundle above the ray given by \( r^* \), it is facing affordability problems with respect to the good \( w \). Taken from the other way, if a household chooses a consumption bundle below this target ray, it is not facing affordability problems in this respect.

For \( r = r^* \), Equation (2) simplifies to

\[
q^w = \frac{q^w}{q^c}q^c
\]

A fourth normative straight line in the model is the minimum budget \( b^* \), called the ‘poverty (budget) line’ (Kessides et al., 2009: 11). This minimum budget \( b^* \) is needed to reach the subsistence bundle \( S \). Thus \( S \) determines its position, while its slope depends on the relative prices of \( w \) and \( c \). All households falling below the minimum budget are considered to be poor. Just like \( r^* \), \( b^* \) is actually a secondary normative term, derived from the minimum quantities (multiplied by the given price vector).

These four straight lines give rise to eight areas, marked from 1a to 4b in Figure 1. Thus, this model differentiates eight situations in which a household may end up. To describe them, we use two basic differences: first, under-consumption versus non-under-consumption; and second, reasons for under-consumption, namely ability deficiency (due to budget constraints) versus willingness deficiency (due to differing preferences). As a result, we obtain four relevant areas, 1 to 4 (see Figure 1).

1) **Non-under-consumption** (gridded area 1). Households in this area are not facing an under-consumption problem. This is caused by two conditions: first, the household has a budget at its disposal which is greater than the target budget \( b^* \); second, on its budget line the household chooses a consumption bundle which avoids under-consumption of both water \( w \) and the representative other good \( c \). One might argue that there is no problem here for social policy. But the CAR \( (r) \) tells us that in area 1a unaffordability is incurred: wealthy households spend more than the target share on consumption of the index good. This misleading indication could be seen as ‘wasting-related unaffordability’. In the housing domain, Lerman & Reeder talk about a ‘taste for penthouse living’.

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9 Quite the contrary: the problem of over-consumption with respect to scarce resources like water may arise. In this paper, however, we have to leave this unconsidered.
In Thalmann (1999: 1935) this false indication is called ‘type I misclassification’ of the CAR.

(2) **Willingness deficiency-related under-consumption** (striped area 2). One of the goods is underconsumed, though not due to budget constraints but following accordant preferences. Households in this area possess sufficient income enabling them to reach an appropriate consumption level for both goods. They just do not choose accordingly. Hancock (1993: 131) calls this the case of ‘perversity of preferences’. Though the CAR \((r)\) tells us that for consumption points in area 2a we again face unaffordability, one might argue that this (pseudo) problem turns out to be a preference-driven (i.e., voluntary) ‘unaffordability’. But one needs to be careful: this is a willingness-driven under-consumption only in the microeconomic household model. In fact, there might be certain ‘non-income constraints’ (Hancock, 1993: 131) that force a household into such a consumption decision and which are essential for the notion of affordability. Thus these households are the most interesting for affordability research (Miniaci et al., 2008: 208) and at that point the theoretical research on affordability has to move on (Gawel & Bretschneider, 2010; Bretschneider, 2012).

(3) **Under-consumption due to both a deficiency of willingness and of ability** (light grey area 3). Here the households have an available income smaller than the target budget \(b^*\). These households cannot reach the subsistence bundle but they are somehow making a wrong decision anyway: they are under-consuming one good while at the same time already consuming more than is necessary of the other. Here we are facing a deficiency of both ability and willingness. Accordingly, meritotic and distributional problems arise at the same time. Considered graphically, the paternalistic third party would like the household to shift on its budget line at least until the point where the dark grey area starts, that is to say, to reduce the consumption of the ‘over-consumed’ good in favour of the under-consumed one, to under-consume the latter less intensely. Systematically, after this movement, the problem of ability still remains – and this is the difference between this and the same scenario in the striped area. Looking at the CAR \((r)\) in this field, we get a diagnosis of ‘unaffordability’ for the top left area 3a ignoring the mixed-conditioned under-consumption. On the other hand, the ‘affordable’ diagnosis for households in area 3b ignores the deficiency of ability they have to deal with.

(4) **Pure ability deficiency-related under-consumption** (dark grey area 4). Those households that end up in area 4 consume insufficient quantities of both goods due to a pure distributional problem with an actual deficiency of ability. This area includes those who ‘do not even have the opportunity to make [an] inappropriate decision’ (Glied, 2009: 15). According to the CAR \((r)\), poor households in area 4b do not face any affordability problems. Since they are consuming a very small quantity of the good they are erroneously considered as having no affordability problem (share of income for water expenses is low). But obviously overcoming affordability problems by mere under-consumption is not a convincing solution. Rather, the critical shortage given in area 4b depicts a severe case of unaffordability. In the housing literature, Lerman & Reeder (1987: 393) talk about ‘living in a shack’, and Thalmann (1999: 1936) about a ‘type II misclassification’ of the CAR.

Having described the model we can now consider two prominent alternatives to the CAR: the ‘Potential Affordability Approach’ (PAA) and the ‘Residual Income Approach’ (RIA). The PAA (Lerman & Reeder, 1987; Thalmann, 1999; Foster & Yepes, 2006; Miniaci et al., 2008; Kessides et al., 2009; 10See the discussion of the PAA and RIA measure below. 11In Figure 1 these are households with a budget equal to or smaller than the budget that intersects the ordinate at \(q^{w*}\).
García-Valiñas et al., 2010a, b) is driven by the insight that households may under-consume water and be indicated as having no problem (3b and 4b), and conversely may over-consume water and be indicated as having a problem (1a and 2a). Thus, instead of the factual expenses, potential expenses for the index good (e.g. water) are used to display the burden share; i.e. the water price $p^w$ is multiplied by the standard consumption level $q^{w*}$.

$$r_p = \frac{p^w q^{w*}}{b}$$

(5)

In Figure 1, a fictitious movement is made on the household’s budget line (parallel to the minimum budget line $b^*$), until the point where the $q^{w*}$ line is intersected (Gawel & Bretschneider, 2011: 26). At that point, the comparison with $r^*$ is made: there is an affordability problem for the household if $r_p > r^*$. This leads to the result that all households ending up under the minimum budget $b^*$ are considered to face affordability problems. We have to note, though, that affordability in this concept is simply reduced to a problem of low income (Thalmann, 2003: 296; Gawel & Bretschneider, 2011: 30). Thus, the PAA goes back to the recommendations of academic welfare economics just to separate allocative and distributive problems. The PAA obviously only indicates problems of income deficit, i.e. problems of general poverty instead of water-related affordability problems. On the other hand, for conditions of dysfunctional political systems of social security this measure might provide orientation for a (second best) social policy for a certain consumer market (in this case, the market for drinking water). Thus problems of income poverty might be pragmatically redefined as problems of affordability, although there is no genuine, poverty-independent definition of affordability.

The second alternative, the ‘RIA’, is a measure working with a difference instead of a ratio (Dolbeare, 1966; Grigsby & Rosenberg, 1975; Stone, 1990, 1993, 2006; Hancock, 1993; Thalmann, 1999, 2003; Kutty, 2005; Miniaci et al., 2008; Kessides et al., 2009). Basically the residual income is defined as:

$$b_{Res} = p^c q^c = b - p^w q^w$$

(6)

To identify affordability problems, a minimum residual income $b_{Res*}$ has to be defined normatively. In our model it equates to the value of the minimum quantity $q^{c*}$. A problem is identified if $b_{Res} < b_{Res*}$. In Figure 1, all households ending up left of the $q^{c*}$ straight line are considered to face affordability problems.

There are two more variations of the RIA. The first is an RIA based on standard consumption levels, just like the PAA. As shown in Gawel & Bretschneider (2011: 28), the households identified having affordability problems are exactly the same as those identified by the PAA based on a ratio. The second variation of the RIA adds a second condition to that of the simple RIA (Hancock, 1993: 135; Miniaci et al., 2008: 207–208). Accordingly, a household is facing an affordability problem if:

$$b - p^w q^w < b_{Res*}$$

(7)

or

$$b - p^c q^c < p^w q^{w*} \text{ with } q^c > q^{c*}$$

(8)
The intention of such a condition is to include households in the problematic areas 2b and 3b that putatively solve affordability problems by underconsuming water (Miniaci et al., 2008: 207–208). Thus, for this definition, which is a ‘double RIA’, all areas in Figure 1 except area 1 are considered to be facing affordability problems. This equates to all households which under-consume either water or other goods. In our study, we apply this ‘double’ condition as an RIA, as presented in Equations (7) and (8). The problem with this measure is that it is not able to separate under-consumption due to non-income constraints from under-consumption due to deficiency of willingness.

If we define the PAA and the RIA like this, the graphical difference between these two criteria is the striped area 2 (see Figure 1). This area is crucial for a genuine notion of affordability problems. There, a desirable measure of affordability would isolate those households whose under-consumption is due to ‘non-income constraints’ (Hancock, 1993). These are non-poor households with (genuine) affordability problems. But within area 2 they would have to be separated from households with a mere deficiency of willingness12. In other words, the truth lies somewhere between PAA and RIA but, obviously, such a perfect measure has not yet been found. Therefore, subsidizing based on the PAA would miss households with genuine affordability problems but, on the other hand, if it is based on the RIA, households who do not face any affordability problems would be subsidized as well.

Apparently there is no final concept and measure of affordability per se. But there are three prominent corresponding concepts of water-related indigence under discussion, which can be generalized with respect to affordability issues and summed up as follows (see also Table 2 and Figure 2(a)–(c)):

- the first concept is burden share, the basis of the CAR (Table 2, first row and Figure 2(a)). This concept alleges a problem if a household spends more on utility goods consumption than the target ratio allows (areas 1a + 2a + 3a + 4a in Figure 1);
- the second concept indicates income restraints (second row and Figure 2(b)). It suggests that areas 3 and 4 are problematic, i.e. households in these areas earn less than needed to afford the subsistence bundle. This concerns the PAA13;
- finally, in the third concept which is based on the meritoric perspective of under-consumption, public policy is required to prevent consumption in areas 2 + 3 + 4 (third row and Figure 2(c)). The appendant measure in this case is the (‘double’) RIA.

<table>
<thead>
<tr>
<th>Concept of indigence</th>
<th>Measurement</th>
<th>Areas in Figure 1</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Burden share</td>
<td>Conventional Affordability Ratio (CAR)</td>
<td>1a + 2a + 3a + 4a</td>
<td>Household spends more on utility good consumption than the target ratio</td>
</tr>
<tr>
<td>2 Budget restraints</td>
<td>Potential Affordability Approach (PAA)</td>
<td>3 + 4</td>
<td>Household earns less than needed to afford the subsistence bundle</td>
</tr>
<tr>
<td>3 Under consumption</td>
<td>Residual Income Approach (RIA)</td>
<td>2 + 3 + 4</td>
<td>Household consumes less than required</td>
</tr>
</tbody>
</table>

12 Moreover, in area 2b households with affordability problems would have to be isolated from those with problems of (physical) access, see Section 4.1.

13 As already mentioned, this also applies to an RIA based on standard water consumption levels.
Comparing these concepts of indigence, the CAR appears to be particularly unqualified to indicate potential need for public action. On one hand it ignores relevant settings (area 4b) and, on the other hand, it turns unpromising consumption patterns into pretended problem cases (area 1a). An affordability analysis relying solely on the CAR, as was conducted for example by the World Bank (2010) in the Mongolian study, suffers from severe shortcomings, which can be summarized as follows:

Fig. 2. Three concepts of indigence: graphical analysis (Source: after Hancock (1993: 130–131) and Gawel & Bretschneider (2011: 24)).
1. there is no correlation to a certain minimum consumption level of the index good. Poor households consuming a very/too small quantity of the good are considered to have no affordability problem (areas 4b, 2b and 3b);
2. similarly, there is no correlation to a maximum consumption level of the index good. Wealthy households ‘wasting’ the index good may be considered to have an affordability problem (area 1a);
3. there might be cases of ‘under-consumption of other goods’ which are caused by ‘perversity of preferences’, not by budget restrictions (area 2a);
4. households are characterized by different amounts of members (household size), different climatic/regional conditions, and different technological endowments. These non-income conditions lead to a different necessity which a fixed ratio measure cannot properly answer to;
5. another aspect is that the functionality of the CAR depends on certain requirements of the price and income elasticity of demand as well as on the tariff function \( p(q) \) (Gawel & Bretschneider 2011: 18). However, for our case study, the latter aspect is not relevant, due to the assumption that \( p = \text{const.} \)

### 3.2. Normative framework for the case study

In order to analyse affordability problems in Mongolia and to compare the performance of the three concepts of water-related indigence, we need to determine the normative terms \( b^* \) and \( r^* \). Hence, we also have to fix the minimum quantity of water \( q^{w*} \) and the minimum quantity of the reference good \( q^{c*} \).

For the definition of \( q^{w*} \) we employ an average value of 30 litres per capita per day. This is (approximately) a mean value of what the different international organizations suggest. Standard values of drinking water required to meet basic needs range across a spectrum of 15–25 litres (UNICEF/WHO, 2008), to 30–50 litres per capita per day (UNICEF & UNDP, 2008). In Figure 3, using the value of 30 litres per day, an amount of 900 litres per month (30 days) is displayed\(^{14}\).

Since there is no physical definition of the virtual variable \( q^{c*} \), a minimum budget \( b^* \) is defined instead: for our purposes, we choose a poverty line (i.e. a minimum income) of 92,000 Mongolian Tugrik (MNT) per capita a month\(^{15}\). This figure is taken from the Mongolian Statistical Yearbook 2009 (NSOM, 2010) where a ‘minimum subsistence level of population per capita a month’ is given for different years and regions\(^{16}\). For the ‘Central Region’ where the city of Darkhan is located, the ‘minimum subsistence level’ quoted for the year 2010 is 91,700 MNT per capita per month\(^{17}\). This

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\(^{14}\) There are studies that focus on the estimation of basic water need, see García-Valiñas et al. (2010a: 2697–2698) which includes further references.

\(^{15}\) This equates to about US$73 (September 2011).

\(^{16}\) The minimum subsistence level of population in Mongolia ‘refers to a minimum consumption level expressed in monetary value; and minimum consumption level refers to a scientific estimation on quantity of consumption to satisfy basic survival requirement defined by food and non-food consumption basket’ (NSOM, 2010: 295).

\(^{17}\) The differences between the five distinct Mongolian regions are marginal. The minimum value is 91,500 MNT (Khangai region) and the maximum value is 101,600 MNT (Ulaanbaatar region).
number is rounded up to 92,000 MNT. We have chosen to convert the per capita minimum income to the household level by multiplying the monthly per capita minimum income (92,000 MNT) by the number of household members.\(^{18}\)

As well as these two normative figures, the water price at the water kiosks in Darkhan (which amounts to 2 MNT per litre) is also important.\(^{19}\) Figure 3 shows the micro-model employing the previously mentioned Mongolian numbers for \(q^{w*}\), \(b^*\) combined with a water price of 2 MNT per litre. A special feature here is that we can work with a constant volumetric price, which allows us to consider price and quantity separately, just as in the traditional microeconomic perspective.\(^{20}\)

If a household possessing exactly the minimum budget of 92,000 MNT spends the whole amount on water, it would be able to purchase 46,000 litres (see the ordinate intercept in Figure 3). If a household consumes the minimum amount \(q^{w*}\) for water, it spends 1,800 MNT per month (not displayed in the figure). In this case a household disposing of the minimum budget consumes the subsistence bundle \(S\) whose burden ratio for water consumption amounts approximately to \(r^* = 2\%\).\(^{21}\) This can be considered as a derived or implicit target ratio in contrast to the postulated 3\% target ratio used by the World Bank (2010: 26).

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\(^{18}\) This method assumes that all members within the household consume equal shares of the total consumption and costs increase in proportion to the number of people in the household; it neglects that, due to economies of scale and different needs mainly based on age and gender, the needs of a household do not grow in a proportional way with each additional member. There are other methods that take into account these aspects (equivalence scales) but there is not one accepted method. The National Statistical Office of Mongolia simply uses a per capita adjustment for household composition (NSOM, 2009: 63–64).

\(^{19}\) This water price holds for the date of the survey, September 2009.

\(^{20}\) By contrast, due to the more complex tariff structures in their study on water affordability in Italy, Miniaci et al. (2008) worked with expense (i.e. price multiplied by quantity).

\(^{21}\) Figure 3 assumes a single-person household. The figures used are accordingly multiplied for multiple-person households, whilst the derived target ratio \(r^*\) of 2\% remains, of course, the same.
3.3. Statistical evaluation of the affordability data in the case study

The household survey conducted in a selected ger area subdistrict in Darkhan (see Section 2) entailed data about household income, household size and household expenditure on kiosk water\(^{22}\). The data for household income and household size show that 82% of the households surveyed were poor, i.e. earn less than 92,000 MNT per capita per month. The lowest income amounts to 6,500 MNT per capita per month, whilst the highest was 333,333 MNT per capita per month.

Table 3 shows the household income distribution for all households, by ventile of income. For every income group, the average annual household income, the average annual household expenditure on kiosk water and the average affordability ratio has been calculated\(^{23}\). A household in the lowest ventile of income earns on average 676,000 MNT per year and spends 23,117 MNT per year on kiosk water. This corresponds with a mean CAR of 7.4%. Figure 4 shows the affordability ratio gradient for all 20 income groups.

<table>
<thead>
<tr>
<th>Income ventile (i.e. each of 5% of households)</th>
<th>Average household income (MNT/year)</th>
<th>Average household expenditure on kiosk water (MNT/year)</th>
<th>CAR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (lowest)</td>
<td>676,000</td>
<td>23,117</td>
<td>7.4</td>
</tr>
<tr>
<td>2</td>
<td>1,016,000</td>
<td>22,265</td>
<td>2.2</td>
</tr>
<tr>
<td>3</td>
<td>1,260,000</td>
<td>23,117</td>
<td>1.8</td>
</tr>
<tr>
<td>4</td>
<td>1,490,000</td>
<td>28,592</td>
<td>1.9</td>
</tr>
<tr>
<td>5</td>
<td>1,620,000</td>
<td>29,565</td>
<td>1.8</td>
</tr>
<tr>
<td>6</td>
<td>1,880,000</td>
<td>30,417</td>
<td>1.6</td>
</tr>
<tr>
<td>7</td>
<td>2,066,000</td>
<td>45,017</td>
<td>2.2</td>
</tr>
<tr>
<td>8</td>
<td>2,174,000</td>
<td>31,633</td>
<td>1.5</td>
</tr>
<tr>
<td>9</td>
<td>2,400,000</td>
<td>30,417</td>
<td>1.3</td>
</tr>
<tr>
<td>10</td>
<td>2,400,000</td>
<td>54,142</td>
<td>2.3</td>
</tr>
<tr>
<td>11</td>
<td>2,600,000</td>
<td>32,242</td>
<td>1.3</td>
</tr>
<tr>
<td>12</td>
<td>2,700,000</td>
<td>30,417</td>
<td>1.1</td>
</tr>
<tr>
<td>13</td>
<td>2,900,000</td>
<td>43,070</td>
<td>1.5</td>
</tr>
<tr>
<td>14</td>
<td>3,480,000</td>
<td>45,017</td>
<td>1.3</td>
</tr>
<tr>
<td>15</td>
<td>3,600,000</td>
<td>39,542</td>
<td>1.1</td>
</tr>
<tr>
<td>16</td>
<td>3,992,000</td>
<td>45,625</td>
<td>1.1</td>
</tr>
<tr>
<td>17</td>
<td>4,610,000</td>
<td>40,758</td>
<td>0.9</td>
</tr>
<tr>
<td>18</td>
<td>4,800,000</td>
<td>30,417</td>
<td>0.6</td>
</tr>
<tr>
<td>19</td>
<td>5,900,000</td>
<td>29,200</td>
<td>0.5</td>
</tr>
<tr>
<td>20 (highest)</td>
<td>8,920,000</td>
<td>49,883</td>
<td>0.7</td>
</tr>
</tbody>
</table>

\(^{22}\) Household income was measured by a direct question (‘What is the total monthly income of this household?’). The household expenditure on kiosk water was calculated based on the household water consumption (underlying question: ‘How many litres of water does your household consume every day?’), whilst the water tariff was 2 MNT per litre at the time of the survey.

\(^{23}\) The average affordability ratio of the income groups was calculated on the basis of the ratio of every single household within every group (and not based on the average values for income and expenditure on kiosk water on a group level).
The (mostly implicit) assumption for the application of the CAR is that the burden ratio declines, the higher the income gets. This is, of course, not a priori the case; it rather depends on the characteristics of the demand function\textsuperscript{24} and it becomes even more demanding when complicated tariff functions prevail. In our study, it is less complicated as there is a constant price of 2 MNT per litre. In this case, the only condition for a declining burden share for increasing income is an income elasticity less than 1 (Gawel & Bretschneider, 2011), i.e. the (at least relative) inferiority of the water demand. This should be the case for the whole sample, but also for each step of increasing income. But, as can be seen in Figure 4, the latter is not the case. In five out of 19 steps, the CAR increases (moving from left to right in Figure 4). For these steps, water consumption is in fact income elastic.

The affordability ratio for the bottom ventile of 7.4\% is conspicuously high. For all other income groups, the affordability ratio amounts to less than the World Bank’s target ratio of 3\%. If the affordability ratio for quintiles of income is calculated, the affordability ratio of the bottom quintile of income is 3.3\%, i.e. almost within the norm of the World Bank. This shows that the result of a 3\% application depends strongly on the number of statistically created income groups: the more detailed the grouping, the bigger the range of affordability ratios. With regard to the World Bank study, the 3\% limit would presumably have been exceeded if the data had been presented in deciles and not in quintiles (the affordability ratio of the bottom quintile of income earners is already 2.8\% i.e. very close to 3\%). Thus, as well as the question of adequately defining the target ratio $r^\ast$, there is also a second aspect which has to be kept in mind in the internal debate of the CAR\textsuperscript{25}.

\textsuperscript{24} OECD (2003: 40) shows examples where the burden ratio declines monotonously. On the other hand, Fankhauser & Tepic (2007) used data applying the CAR where the burden share does not strictly decline with income (Gawel & Bretschneider, 2011: 14–15).

\textsuperscript{25} Here we present a discussion that mainly criticizes the CAR, as such. However, these two internal aspects concern how a CAR has to be treated once it is applied.
For further analysis, a simple linear regression model was applied to the relationship between water consumption and income (see Figure 5). For more sophisticated multiple regression models of water demand, see Arbués et al. (2003), Dalhuisen et al. (2003) and Worthington & Hoffman (2008) (with further references).

There are two households with an extraordinarily high water consumption of 40 and 38 litres per capita per day, respectively. A closer look at the dataset provides a plausible explanation: these households consume a lot of kiosk water for horticultural activities or livestock breeding. The very high income of 333,000 MNT per month per capita of another household may be explained by the fact that the dwellers own a lot of animals (100 goats, 100 sheep, horses and yaks).

There is a slight positive correlation between the level of water consumption $q_w$ and the income level ($r^2 = 0.099$, Sig. 0.000) (see Figure 5). The regression equation is:

$$q_w = 9.616 + 0.043b$$

(9)
According to the regression equation for a mean income (66,228 MNT per month per capita, divided by 1,000) the water consumption amounts to 12.46 litres per day per capita. The overall income elasticity of water demand follows as:

\[ \eta_{q^*b} = \frac{dq^w}{db} \times \frac{b}{q^w} = 0.043 \times \frac{66.228}{12.46} = 0.23 \]  

Hence, the water demand is (incompletely) income inelastic; this is a common result for water (see Worthington & Hoffman (2008: 862) with further references). This (relative) inferiority actually speaks in favour of the CAR. But such an overall elasticity misses certain details, as mentioned in discussion of Figure 4 above, where we stated that there are indeed income elastic steps when income is increasing.

With the data collected, it is now possible to classify each of the 120 households in the microeconomic model we have normatively prepared in Section 3.2. We are able to identify which area a household ends up in (see Figure 6). In the illustration, however, a second CAR target ray is displayed, i.e. the target ray of \( r^* = 3\% \) as used by the World Bank (2010). Its slope is obviously higher than that of the derived CAR of 2\%. This leads to 12 areas from 1aa to 4b. For each area, the percentage of households that end up in the corresponding field is displayed.

Along the lines of our theoretical considerations, we can now pool a bundle of areas according to the above-mentioned concepts of indigence (see Table 4). At the head of the table, the concepts of indigence are displayed. Now there are two criteria for CAR: the external one used by the World Bank (3\%, CAR₁) and the internal one derived from minimum norms for a household’s budget and water consumption (2\%, CAR₂). Aside from this, there is the concept of budget restraints being identical with the PAA. Finally, the criterion of under-consumption (RIA) can be applied.

In the rows in Table 4, the 12 areas which can be differentiated according to Figure 6 can be found. Each concept of indigence identifies, for each area, whether there is an affordability problem for the
Table 4. Affordability case groups and their frequency of occurrence (grey areas indicate an affordability problem; \( n = 120 \)).

<table>
<thead>
<tr>
<th>Case group/area</th>
<th>Features</th>
<th>Indication according to external target ratio 3% (CAR(_1)) ((r &gt; r^n_1, b \geq b^*))</th>
<th>Indication according to derived (internal) target ratio 2% (CAR(_2)) ((r &gt; r^n_2, b \geq b^*))</th>
<th>Indication according to household’s budget restraints (PAA) ((b &lt; b^*))</th>
<th>Indication according to under consumption (RIA) ((q^w &lt; q^w^* \lor q^c &lt; q^c^*))</th>
<th>Share of households in the case group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1aa (gridded)</td>
<td>(q^w \geq q^w^<em>, q^c \geq q^c^</em>, r &gt; r^n_1, b \geq b^*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>1ab (gridded)</td>
<td>(q^w \geq q^w^<em>, q^c \geq q^c^</em>, r \geq r^n_2, b \geq b^*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>1b (gridded)</td>
<td>(q^w \geq q^w^<em>, q^c \geq q^c^</em>, r \leq r^n_2, b \geq b^*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2aa (striped)</td>
<td>(q^w \geq q^w^<em>, q^c &lt; q^c^</em>, r &gt; r^n_1, b \geq b^*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2ab (striped)</td>
<td>(q^w \geq q^w^<em>, q^c &lt; q^c^</em>, r \geq r^n_2, b \geq b^*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2b (striped)</td>
<td>(q^w &lt; q^w^<em>, q^c \geq q^c^</em>, r &lt; r^n_2, b \geq b^*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18.3</td>
</tr>
<tr>
<td>3aa (light grey)</td>
<td>(q^w \geq q^w^<em>, q^c &lt; q^c^</em>, r &gt; r^n_1, b &lt; b^*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.8</td>
</tr>
<tr>
<td>3ab (light grey)</td>
<td>(q^w \geq q^w^<em>, q^c &lt; q^c^</em>, r \geq r^n_2, b &lt; b^*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.5</td>
</tr>
<tr>
<td>3b (light grey)</td>
<td>(q^w &lt; q^w^<em>, q^c \geq q^c^</em>, r \leq r^n_2, b &lt; b^*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.8</td>
</tr>
<tr>
<td>4aa (dark grey)</td>
<td>(q^w &lt; q^w^<em>, q^c &lt; q^c^</em>, r &gt; r^n_1, b &lt; b^*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.5</td>
</tr>
<tr>
<td>4ab (dark grey)</td>
<td>(q^w &lt; q^w^<em>, q^c &lt; q^c^</em>, r \geq r^n_2, b &lt; b^*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.2</td>
</tr>
<tr>
<td>4b (dark grey)</td>
<td>(q^w &lt; q^w^<em>, q^c &lt; q^c^</em>, r \leq r^n_2, b &lt; b^*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>55.8</td>
</tr>
<tr>
<td><strong>Total households with identified indigence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>8.3%</strong></td>
</tr>
</tbody>
</table>
household (grey) or not (white). So far, this is just a different illustration of the fact that the concepts vary a lot in their respective diagnoses (see again Figure 2(a)–(c)). Only for three areas do they show the same result (1b, 3aa and 4aa).

In the very right column of Table 4, the empirical data of our case study are added, i.e. the percentage values already displayed in Figure 6. The bottom row then sums up the percentage of households for which an affordability problem can be diagnosed, according to a certain concept. The difference in the diagnoses is astonishing at first sight: one indicator identifies problems for 8.3% of all households, another one for all (100%).

4. Discussion

4.1. Problems of contradicting and misleading measures and the role of non-pecuniary cost

As seen in Section 3.1, the contradiction between the three concepts of indigence are already remarkable from a theoretical point of view. With the help of empirical figures (as seen in Section 3.3), these contradictions turn out to be even more relevant in practice. The number of households facing an affordability problem is quite small for the CAR (8.3 and 25%), whereas for the ‘improved measures’ of PAA and RIA the corresponding shares are much higher (81.7 and 100%). Thus, even with a share of 8.3% of unaffordability (by applying an external CAR of 3%) the World Bank’s (2010: 26) findings (no affordability problems at all) no longer hold true. Moreover, the application of an internal target ratio (2%) for CAR, meeting local conditions, even shows an increase of up to 25% in households facing affordability problems.

In addition, 81.7% of the households face affordability problems, according to the PAA. As explained in Section 3.1, the PAA basically gives information about income poverty. There might be a genuine underlying affordability problem which, however, is superimposed by the problem of general poverty. Finally, all of the households face affordability problems according to the RIA (100% of the sample). These are all households identified according to the criterion of under-consumption; i.e. the PAA plus area 2 in Figure 1. Empirically, 18.3% of the households end up in area 2b. These are households that possess the necessary minimum budget $b^*$ (i.e. 92,000 MNT per month) but under-consume water anyway; it has already been mentioned in Section 3.1 that it is theoretically unclear whether households of this type ‘do not want’ to consume an amount that is paternally considered to be at least necessary (willingness deficiency) or whether this decision is due to certain non-income constraints revealing real affordability problems (e.g. the costs of (physical) access). Thus, in area 2b (under-consumption of water) we face possible causes that have to be separated thoroughly from the actual problem of affordability. Non-income constraints of access as a hurdle for consumption of potable water are widely discussed, especially for problems of water provision in developing countries (e.g. Anand, 2007; González-Gómez et al., 2011; Sorenson et al., 2011). With respect to a sound measurement of affordability deficiencies, taking cost of access into account the ‘truth’ lies between the PAA and the RIA, but there is no measure to properly isolate access problems from under-consumption due to deficiency of willingness. In our case study, we empirically find that all households that are not poor (income higher than $b^*$) do in fact under-consume water (area 2b). This might reveal that there is a somehow dominant non-income constraint: since the purchase of kiosk water is accompanied by significant non-pecuniary costs, there might be a general access problem to an extent that it finally leads to under-consumption of (at least kiosk) water.
The problem of access was also considered by the World Bank, which argued that under-consumption was due to ‘inconvenient transportation’ (World Bank, 2010: 26). Obviously, in this field, we face the potentially superjacent problems of poverty, affordability and non-pecuniary costs of access. Figure 7 displays a systematic framework that shows how the problems of affordability and of access interact (Gawel & Bretschneider, 2012b). This framework is based on the contractual relation between water supplier and user. The crucial category is the service level, i.e. how far the service approaches the household. If there is no home delivery of water, as is typical for many areas in developing countries (as, for example, in our case study) certain costs of ‘household production’ will arise (Becker, 1965) – this refers to the effort of going to the kiosk and carrying water (problem of costly access).

However, the service fulfilled by the utilities has to be financed in some way. Economic arguments speak up for coverage by consumer recompense. In the absence of public subsidies, recompense by consumers remains the only source for financing the service. Recompense (raising the question of affordability) and household production (raising the question of access) represent, in conjunction, the ‘household’s condition’, i.e. the pecuniary and non-pecuniary costs for water consumption. The ‘supplier’s condition’, on the other hand, i.e. the costs of supply, depends on the service level. For developed countries, the service is (partly) financed by transfers, in order to keep the pecuniary costs for users affordable.

If one imagines the arrows in Figure 7 to be flexible in length, it becomes plausible for recompense and household production to substitute for each other. In fact (though not necessarily normatively), this is the solution for water provision to financially poor households (as many households in developing countries are). To keep the service affordable, the service level is reduced and the household production, i.e. the cost of access, is simultaneously raised.

Consideration of the PAA and the RIA show that we face a complex constellation of social policy problems in which a genuine affordability problem is not easy to identify. The intense problems of poverty (referred to by PAA) and of under-consumption and access (addressed by RIA) appear to superimpose the actual problem of affordability, which is still not defined in a theoretically consistent way. But a clear denial of affordability problems cannot be confirmed here either.

Fig. 7. Contractual relation between water supplier and user.
4.2. Institutional pitfalls of measuring water-related affordability: the case of Mongolia

Affordability analysis is additionally compromised by a number of institutional pitfalls of empirical data collection. First of all, the water expenses figures themselves include some pitfalls. One source of error is obviously the household’s ambivalent awareness of how much water it consumes and what it spends on it. In the household survey, the data on water expenses based on the question ‘how much money does your household usually spend on water?’ are significantly higher than those of the calculated data based on the given water price and the collected data on water consumption (underlying question: ‘How many litres of water does your household consume every day?’). In this paper, we have used the calculated data because we assume that the residents are much more aware of how much water they consume than they are of how much money they spend on water.

But we also encounter several stumbling blocks to sound empirical work with regard to the quantity of water consumption: the household survey revealed that 43% of the residents interviewed not only use water from the water kiosk but also additional water sources, such as water from rainwater harvesting or water from other households with private wells (presumably households located outside the study area). This additional water is not monitored and bears the risk of being contaminated. Furthermore, the low water consumption in the study area can partially be explained by the fact that only 19% of the respondents reported having a shower or bath, at least sometimes, at home. Instead, they go to other people’s homes, mainly those of relatives (58%), and/or to the public bathhouse (54%) located close to the study area to shower or bathe (Sigel et al., 2012). Last but not least, the water purchased at the water kiosk (or gained through additional water sources) is not only used to meet basic human needs: some households also use water for horticultural activities or livestock breeding (see Section 3.3). We have tried to account for these distortions in our affordability analysis but we do not have enough data on the water quantities and costs linked to the different water practices.

The role of non-pecuniary cost and, accordingly, the costs of ‘household production’ (access) were described in the previous section. In the Mongolian case study, the location of the water kiosks is such that most residents (62%) need up to 10 minutes (in total) to fetch water, 33% need 11–20 minutes and 2% need 21–30 minutes. Only 3% need 30 minutes or longer26. Beyond the effort to go to the kiosk and carry water, residents have to cope with constraints regarding water availability. Water is only available during opening hours, i.e. every day except for Wednesdays and Sundays, from 9 am to 8 pm, with a mid-day lunch break. Furthermore, two out of the 11 water kiosks are still supplied by truck (truck-fed kiosks) and not connected to the central water supply network (pipe-fed kiosks). Water availability and the quality of water from pipe-fed water kiosks is much better than that from truck-fed kiosks27. Sometimes the water supply service breaks down completely, for example during winter time, when there is a risk of water in the pipes freezing.

Certainly, a sound affordability measurement has to take these institutional pitfalls into account in order to avoid distorted results. As the security of kiosk water supply is at risk and costly in terms of

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26 Hence, the time needed to collect water generally does not exceed the maximum standard of 30 minutes, as defined by the Joint Monitoring Programme for Water Supply and Sanitation (which aims to monitor the achievement of the Millennium Development Goals).

27 According to the local service provider, USAG, water consumption in the study area has increased five-fold since the nine water kiosks have been connected to the central grid (interview statement; September 2010).
inconvenience (and certain alternatives for water provision are at hand such as bathhouses) under-consumption of kiosk water is hardly surprising – as is the overall lack of a relevant burden derived from kiosk water expenses indicated by the simple CAR measure. But the excess burden imposed by the non-pecuniary cost of purchase or by substitutions of provision pathways (e.g. bathhouses) cannot be measured by regarding the expense of kiosk water alone. Thus the under-consumption of kiosk water by the poor may render unaffordability invisible but does not make it non-existent.

5. Conclusion

A theoretically consistent affordability criterion is needed to derive sound recommendations for water policy. For empirical measurement, however, the CAR is still widely used, although housing affordability literature in particular has pointed out its shortcomings: CAR is theoretically defective and hence misleading in practice. Consequently, some alternative affordability measures have been developed, among them the ‘PAA’ and the ‘RIA’ in an attempt to overcome the weaknesses of a simple CAR measurement. Applications of new approaches and, in particular, empirical comparisons of alternative measures of affordability have hardly been conducted in the water domain so far. The PAA can be considered theoretically consistent but reverts to the simple recommendations of academic welfare economics, suggesting the separation of allocative and distributive problems of water use: once social policy succeeds in easing relevant income restrictions, resource prices can be set in an efficient way. In practice, this ‘Nirvana’ condition cannot be fulfilled, even less so by the authorities or firms who decide on utility tariffs. For practical water or energy resource management, the problem of affordability of utility service prices cannot be solved in this way. The RIA, as considered here, is equivalent to the notion of under-consumption. In addition to households already identified by the PAA, households which under-consume water (or ‘other’ goods) are presumed by the RIA to have problems, despite possessing a sufficient budget. For these households, it is crucial to identify whether they just prefer such a consumption bundle (a matter of willingness) or whether they face certain ‘non-income constraints’ (a matter of ability). One important non-income constraint is the problem of access. The household data from our case study indicate that, after the problem of poverty, this is a second problem superposing the actual problem of affordability.

Both the PAA and the RIA are parts of the same picture needed to create a sound definition of affordability. Genuine problems of affordability as well as problems of access lie right between what the PAA and the RIA measure in each case. Hence, an indicator is needed that would be able to isolate non-income constraints from ‘perverse preferences’. Accordingly, a recent statement by Muennig et al. (2011) on affordability appears to be misleading: ‘We all want it, but we don’t know what it is.’ We can now amend this to state that ‘we know what it is but we do not know how to measure it’. However, what is certain is that the simple CAR appears to be least helpful for an approximation of affordability issues.

Although the measuring of genuine affordability is so difficult, we feel that a premature denial of affordability problems might be wrong as well. Thus the World Bank’s statement that there is no water affordability problem at all in Mongolia, as found for the peri-urban ger areas in Ulaanbaatar (World Bank, 2010: 26), cannot be confirmed. From our perspective, such a statement is wrong, first and foremost because of the conceptual flaws of the CAR in general. How this measure is applied can also be criticized: first, using income quintiles may be not detailed enough; and second, an ‘internal’ target ratio may be more appropriate. On the other hand, our results show that the problem of access resulting in non-pecuniary cost is effectively a problem for many households and has to be taken
into account. Expense-oriented affordability analysis neglects the excess burden imposed by access problems and runs the risk of deeming under-consumption as a proof for (pecuniary) affordability.

The task of future affordability research remains to come closer to a theoretically meaningful and contoured notion of affordability itself, being at the same capable of measurement and taking into consideration non-pecuniary reasons for under-consumption. This would also help to provide relevant practical advice for water policy in order to get closer to an implementation of the ‘right to water’. In the meantime, social policy aimed at easing income restrictions may still be the most powerful instrument for tackling current affordability deficiencies, particularly in developing countries.

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